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SUSTAINING HEALTH & PERFORMANCE IN COLD WEATHER OPERATIONS

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This technical note reviews how the environment can impact on soldier health and performance during cold weather operations. The physiology of cold exposure, risk factors for cold injuries, clothing systems, shelter, effects of solar radiation and high altitude, food and water consumption, disease, NBC operations, and key points for cold weather operations are presented are synthesized for unit leaders and soldiers.

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ENVIRONMENTAL STRESS DURING COLD-WEATHER OPERATIONS

History is filled with examples of the significant impact of cold on military operations. Among U.S. Army and Army Air Force troops, there were over 90,000 cold injuries requiring medical treatment during World War II, and another 10,000 during the Korean War, accounting for 10% of all casualties experienced during these conflicts. Given that the average air temperature recorded when cold injuries were experienced during World War II was 30°F, and that temperatures this low are experienced over about 60% of the earth's surface, leaders must appreciate cold-weather effects on soldier health and performance. Cold injuries can also occur when air temperatures are above freezing. For example, during the Falkland Islands War, trenchfoot was common among British and Argentinean Forces. **Prevention of cold injuries is the responsibility of commanders at all levels.**

COLD-WEATHER STRESSORS

DIRECT EFFECTS:
1. **COLD TEMPERATURES**
2. **WIND**
3. **RAIN, SNOW, ICE, HUMIDITY**

INDIRECT EFFECTS:
4. **FOOD AND WATER PROBLEMS**
5. **DISEASE AND NONBATTLE INJURY**
6. **OPERATIONAL PROBLEMS**

Cold weather can directly affect an individual's health and performance by lowering body temperature, resulting in cold injuries and impaired performance. Moreover, cold temperatures are often accompanied by **wind, rain, snow, and ice**, which can worsen the effects of cold, as well as contribute to injury and performance impairments in and of themselves. Cold-weather conditions impair many aspects of normal military functioning in the field, which can in turn influence soldier health and performance. **Food and water problems** are common during cold weather, since requirements are high and supply is difficult. Cold weather contributes to increased **disease and nonbattle injury**, since maintaining proper field sanitation and personal hygiene is difficult, sick and injured individuals are susceptible to cold injuries, and the use of indoor stoves may lead to burns or carbon monoxide poisoning. **Operational problems** often arise in cold weather. Bulky clothing restricts movement, equipment often malfunctions, travel can be difficult, cold-weather clothing and NBC protective clothing and equipment are difficult to integrate, and fogging and freezing of eyepieces and windows occurs.

While cold makes military tasks more difficult, they are not impossible and **proper training** can prevent many of the problems with soldier health and performance. Viewing cold as a challenge to be overcome is the key to the positive attitude required to successfully complete the mission. The purpose of this Technical Note is to highlight the effects of cold on the soldier and equipment, and to present ways to minimize these effects.

SUSTAINING HEALTH DURING COLD WEATHER

Cold

Heat flows from areas of high temperature to those of lower temperature. When a person is surrounded by air or water having a lower temperature than body temperature, the body will lose heat. If heat escapes faster than the body produces heat, body temperature will fall. Immersion in water can increase heat loss by 25-fold compared to cold air, therefore wet soldiers are more susceptible to hypothermia than dry soldiers. Normal internal body temperature is 98.6°F (37°C), and if internal body temperature falls to 95.5°F (35.5°C), performance decrements and cold injuries can result.

How Cold Affects the Body:

1. Humans protect themselves from cold primarily by avoiding or reducing cold exposure using clothing and shelter. When this protection proves inadequate, the body has biological defense mechanisms to help maintain correct body temperature, including vasoconstriction (heat conservation) and shivering (heat production).

a. Vasoconstriction is the narrowing of blood vessels in the skin when it is exposed to cold causing **the skin temperature to fall**. The reduced skin blood flow conserves body heat, but can lead to discomfort, numbness, loss of dexterity in hands and fingers, and eventually cold injuries.

b. Shivering can increase internal heat production by as much as 3-5 times. which helps to offset the heat being lost. Physical activity also increases heat production (by as much as 15 times) and may be sufficient to completely compensate for heat loss, even when it is extremely cold. However, strenuous activity is fatiguing and also causes sweating, which reduces clothing insulation.

2. Humans do not acclimatize to cold weather nearly as well as they can acclimatize to hot weather. **Proper physical conditioning and training** before deploying into cold-weather regions is more important for prevention of cold injuries than repeatedly being exposed to cold temperatures.

a. Training outdoors in cold weather before deployment will help build confidence in soldiers' ability to physically, mentally and emotionally contend with the stress of cold-weather conditions.

b. Physical training improves body heat conservation and enables greater sustainment of exercise heat production before becoming fatigued.

Cold Injuries

1. Nonfreezing cold injuries can occur when conditions are cold and wet (air temperatures between 32° and 55°F, or 0° to 13°C) and the hands and feet cannot be kept warm and dry. The most prominent nonfreezing cold injuries are ***chilblain and trenchfoot***.

a. Chilblain, while painful, causes little or no permanent impairment. It appears as red, swollen skin that is tender, hot to the touch and may itch. This can worsen to an aching, prickly ("pins and needles") sensation and then numbness. It can develop in only a few hours in skin exposed to cold/wet conditions.

b. Trenchfoot is a very serious injury that may result in permanent nerve or tissue damage. Constant dampness softens skin, causes blistering or bleeding and may lead to infection. Untreated, trenchfoot may require amputation. Early signs of trenchfoot include itching, numbness or tingling pain. Later the feet may appear swollen, and the skin mildly red, blue or black. Commonly, trenchfoot shows a distinct "water-line" coinciding with the water level in the boot. The risk of this potentially crippling injury is high when troops are exposed to wet conditions for prolonged periods (>12 hours). Soldiers wearing rubberized or tight-fitting boots are at risk for trenchfoot regardless of weather conditions, since sweat accumulates inside these boots and keeps the feet wet.

FIRST AID FOR CHILBLAIN AND TRENCHFOOT

1. **PREVENT FURTHER EXPOSURE**
2. **REMOVE WET OR CONSTRICTIVE CLOTHING**
3. **WASH AND DRY GENTLY**
4. **ELEVATE, COVER WITH LAYERS OF LOOSE, WARM, DRY CLOTHING AND ALLOW TO REWARM (PAIN AND BLISTERS MAY DEVELOP)**
5. **DO NOT: POP BLISTERS, APPLY LOTIONS OR CREAMS, MASSAGE, EXPOSE TO EXTREME HEAT OR ALLOW VICTIM TO WALK ON INJURY**
6. **REFER FOR MEDICAL TREATMENT**

2. Freezing cold injuries can occur whenever air temperatures are below freezing (32° F or 0°C), and in exposed skin, risk increases with higher wind speeds.

a. Freezing limited to the skin surface is ***frostnip***. Frostnip involves freezing of water on the skin surface. The skin will become reddened and possibly swollen. Although painful, there is usually no further damage after rewarming. Repeated frostnip in the same spot can dry the skin, causing it to crack and become very sensitive. It is difficult to tell the difference between frostnip and frostbite. **Frostnip should be taken seriously since it may be the first sign of impending frostbite.**

b. When freezing extends deeper through the skin and flesh, the injury is ***frostbite***. Skin freezes at about 25-28° F (-4 to -2°C). As frostbite develops, skin will become numb and turn to a grey or waxy-white color. The area will be cold to the touch and may feel stiff or woody. With frostbite, ice crystal formation and lack of blood flow to the frozen area damages the tissues. After thawing, swelling may occur, worsening the injury.

c. The use of emollients (e.g., petroleum jelly) does not protect against frostbite. Instead it may give a false sense of security and therefore increase the risk for frostbite.

FIRST AID FOR FROSTBITE

1. **PREVENT FURTHER EXPOSURE**
2. **REMOVE WET, CONSTRICTIVE CLOTHING**
3. **REWARM GRADUALLY BY DIRECT SKIN-TO-SKIN CONTACT BETWEEN INJURED AREA AND NONINJURED SKIN OF THE VICTIM OR A BUDDY**
4. **EVACUATE FOR MEDICAL TREATMENT (FOOT INJURIES BY LITTER)**
5. **DO NOT ALLOW INJURY TO REFREEZE DURING EVACUATION**

NOTE: 1) DO NOT REWARM A FROSTBITE INJURY IF IT COULD REFREEZE DURING EVACUATION; 2) DO NOT REWARM FROSTBITTEN FEET IF VICTIM MUST WALK FOR MEDICAL TREATMENT; 3) DO NOT REWARM INJURY OVER OPEN FLAME

3. Body temperature falls when the body cannot produce heat as fast as it is being lost. ***Hypothermia*** is a life threatening condition in which deep-body temperature falls below 95°F (35°C).

a. Generally, deep-body temperature will not fall until after many hours of continuous exposure to cold air, if the individual is healthy, physically active and appropriately dressed. However, since wet skin and wind accelerate body heat loss, and the body produces less heat during inactive periods, body temperature can fall even when air temperatures are above freezing if conditions are windy, clothing is wet, and/or the individual is inactive.

FIRST AID FOR HYPOTHERMIA

1. **PREVENT FURTHER COLD EXPOSURE**
2. **REMOVE WET CLOTHING**
3. **INITIATE CPR, ONLY IF REQUIRED**
4. **REWARM BY COVERING WITH BLANKETS, SLEEPING BAGS AND WITH BODY-TO-BODY CONTACT**
5. **HANDLE GENTLY DURING TREATMENT AND EVACUATION**

b. Hypothermia can occur rapidly during cold-water immersion (one hour or less when water temperature is below 45°F or 7°C). Because water has a tremendous capacity to conduct heat away from the body, immersion in water considered even slightly cool, say 60°F or 15°C, can cause hypothermia, if the immersion is prolonged for several hours.

c. Exhaustion, physical exercise, repeated cold exposure, inactivity, and poor nutrition can increase susceptibility to hypothermia.

d. **Hypothermia is a medical emergency**. Untreated, it results in death. Hypothermia may be difficult to recognize in its early stages of development. Vigorous shivering is a sign that increased heat production is necessary to main body temperature. Other signs of hypothermia include unusually withdrawn or bizarre behavior, irritability, confusion, slowed or slurred speech, altered vision, uncoordinated movements, and unconsciousness. Even mild hypothermia can cause victims to make poor decisions or act drunk (e.g., removing clothing when it is clearly inappropriate).

e. **Hypothermia victims may show no heartbeat, breathing, or response to touch or pain when in fact they are not really dead**. Sometimes, the heartbeat and breathing of hypothermia victims will be so faint that it can go undetected. If hypothermia has resulted from submersion in cold water, cardiopulmonary resuscitation (CPR) should be initiated without delay. However, when hypothermia victims are found on land, it is

important to take a little extra time searching for vital signs to determine whether CPR is really required. Hypothermia victims should be treated as gently as possible during treatment and evacuation, since the function of the heart can be seriously impaired in hypothermia victims. Rough handling can cause life-threatening disruptions in heart rate. All hypothermia victims, even those who do not appear to be alive, must be evaluated by trained medical personnel.

f. Susceptibility to cold injury (non-freezing, freezing, or hypothermia) is affected by many related factors, including the environment, mission, and individual.

A. Environment Related.

1. **Wind** increases heat loss from exposed skin exposed to cold air and can increase the risk of frostbite. The wind-chill temperature chart (Appendix A) integrates wind speed and air temperature to provide an estimate of the cooling power of the environment and the associated risk of cold injury. The wind-chill temperature is the equivalent still-air (i.e., no wind) temperature at which the heat loss through bare skin would be the same as under the windy conditions. Wind-chill temperatures obtained from weather reports do not take into account man-made wind. Individuals riding in open vehicles or exposed to propeller/rotor-generated wind can be subject to dangerous windchill, even when natural winds are low. Rather than cancel outdoor training at some arbitrary temperature limit, training should be modified and safety surveillance should be increased as the weather becomes more severe, and the danger of tissue freezing increases, as indicated in Appendix B.

2. **Water** can conduct heat away from the body much faster than air of the same temperature. When

COLD INJURY RISK FACTORS:

ENVIRONMENT RELATED:
- **COLD TEMPERATURES**
- **WIND**
- **RAIN, IMMERSION**
- **ALTITUDE (low oxygen)**

MISSION RELATED:
- **SUSTAINED OPERATIONS**
- **INADEQUATE SHELTER**
- **INACTIVITY (e.g. SENTRY)**
- **ERGONOMIC (e.g. LOAD CARRY)**
- **WETLAND OPERATIONS**
- **LACK OF FOOD & WATER**
- **CAMOUFLAGE PAINT ON SKIN**
- **METAL, FUEL**
- **PREVIOUS COLD EXPOSURE**
- **EXERCISE BEFORE COLD**

INDIVIDUAL:
- **FATIGUE**
- **DEHYDRATION**
- **LOW BODY FAT**
- **AGE**
- **ALCOHOL**
- **NICOTINE**
- **POOR NUTRITION**
- **ILLNESS, INJURY, WOUNDS**
- **MEDICATIONS**
- **PRIOR COLD INJURY**
- **POOR CLOTHING & EQUIPMENT**
- **SLEEP LOSS**

clothing becomes wet due to snow, rain, splashing water, immersion, or accumulated sweat, the body's loss of heat accelerates. For example, when air temperature is 40°F (4°C), heat loss in wet clothing is double what it is in dry clothing. Swimmers and persons working or wading in water can lose a great deal of body heat even when water temperatures are only mildly cool. Individuals working in cold water should be closely watched while they enter the water, since sudden plunging into cold water can produce irregular heart beats, gasping, and hyperventilation which could cause inhalation of water, heart failure and drowning. Performing physical exercise before cold exposure increases heat loss

3. When assessing weather conditions for troops operating in mountainous regions or for flight personnel in aircraft, **altitude** must be considered, if weather measurements are obtained from stations at low elevations. Temperatures, windchill and the risk of cold injury at high altitudes can differ considerably from those at low elevations. In general, it can be assumed that air temperature is 3.6°F (2°C) lower with every 1000 feet above the site at which temperature was measured. Winds are usually more severe at high altitude and there is less cover above the tree line. Individuals are more susceptible to frostbite at altitudes above 8,000 feet (2,400 meters) than at sea level, due to the lower temperatures, higher winds and lack of oxygen. Body heat is not conserved as well over altitudes above 6,000 feet (1800 meters), increasing the risk for hypothermia.

B. Mission Related

1. In **defensive fighting positions** like foxholes or small vehicle crew compartments, movement is very restricted and soldiers must often remain inactive inside them for long periods of time, which can greatly increase risk of cold injury. If these areas are wet, trenchfoot can become a serious problem.

2. When the face and other exposed skin areas are covered by **camouflage paint**, it is difficult to see the changes in skin color which signal the early development of frostbite.

3. **Metal objects and liquid fuels** that have been left outdoors in the cold can pose a serious hazard. Both can conduct heat away from the skin very rapidly. Fuels and solvents remain liquid at very low temperatures and become supercooled. Skin contact with fuel or metal at below freezing temperatures can result in nearly instantaneous freezing. Fuel handlers should use great care not to allow exposed skin to come into contact with spilled fuel or the metal nozzles and valves of fuel delivery systems. Thin liner gloves should always be worn when temperatures fall below freezing to reduce the risk of contact frostbite.

C. Individual Related

1. **Poorly conditioned soldiers** are more susceptible to cold injury. They tire more quickly and are unable to stay active to keep warm as long as fit soldiers. Physical fatigue decreases vasoconstriction and increases heat loss. Fatigued soldiers also may make more judgment errors when tired and increase their exposure and risk of injury.

b. **Dehydration** can increase susceptibility to cold injury by decreasing physical performance and cognitive function of the soldier. Dehydrated soldiers become fatigued more easily and may use poor judgment. Dehydration may also blunt vasoconstriction causing greater heat loss.

c. **Body Fat** insulates against heat loss. Therefore, a lean person may be more susceptible to cooling, if clothing is inadequate or wet, or if the individual is relatively inactive such as during sentry duty.

d. **Persons >45 years old** may be less cold tolerant than younger persons, due to either a decline in physical fitness (will fatigue sooner due to working at higher % of maximal aerobic capacity) or inability to vasoconstrict and conserve heat as well as their younger counterparts.

e. **Alcohol** can lower blood sugar levels and decrease shivering. Also, alcohol increases urine formation, leading to dehydration, which can further degrade the body's ability to perform. **Most importantly, alcohol blunts the senses and impairs judgment, so the individual may not feel the signs and symptoms of developing cold injury**.

f. **Smoking or chewing tobacco** can increase susceptibility to frostbite by increasing vasoconstriction in the periphery (e.g. hands).

g. **Inadequate nutrition, and illness and injury** compromise the body's responses to cold due to the inability to shiver as well. They may also decrease the ability to recognize and react appropriately to the symptoms of developing cold injury. **Medications** may interfere with the ability to shiver or vasoconstrict and thus extra care should be taken in cold weather.

i. Individuals who have experienced a **cold injury** in the past are at greater risk of experiencing a cold injury than other soldiers. These soldiers may be more sensitive to the effects of cold, or they may not have learned how to properly protect themselves.

j. Soldiers who are **sleep-deprived** will not be able to sustain physical activity and will increase their risk for hypothermia.

Cold Weather Clothing:

1. Cold-weather clothing systems are designed to accommodate a variety of weather conditions and activity levels. Cold-weather clothing protection is based on the principles of **insulation, layering and ventilation**. By understanding these principles, soldier can vary their clothing to optimize performance and stay comfortable.

a. **Insulation** depends on the amount of air trapped within the garment and properties of the material. For a given weight, a thicker material will trap more air and be a better insulator. When clothing is dirty, the material tends to be packed down, which compromises insulation.

b. Wearing clothing ensembles in multiple **layers** allows insulation to be adjusted to changes in environment or workload as well as to the individual's own needs and preferences. Layered clothing is especially important for soldiers whose duties require them to frequently move in and out of heated shelters, or to periodically undertake vigorous physical activity.

WHEN USING COLD-WEATHER CLOTHING, REMEMBER C-O-L-D:

keep it-------Clean

avoid---------Overheating

wear it--------Loose in layers

keep it--------Dry

c. Physically active people sweat even in extremely cold weather. If sweat cannot evaporate, it will accumulate, wet the clothing, and ultimately compromise insulation. Sweat will be able to evaporate if clothing allows **ventilation**. Proper clothing will be made of material that water vapor can pass through, and will allow the wearer to unzip and open the clothing periodically to increase ventilation. Sweat evaporation will be compromised when clothing is dirty.

d. Appendix C shows two graphs. Graph A depicts the metabolic cost (1 MET = sitting) of walking on various surfaces at different speeds. Graph B shows the clothing insulation necessary for comfort for different metabolic rates and air temperatures. (Clo values for the BDU (1 clo), ECWCS (3.6 clo), Cold/Wet-Cold/Dry (4 clo), ECWCS+MOPP (4 clo), and sleeping bag (8 clo) are shown for comparison). The graphs indicate that when working hard (6 METS), only 2 clo of insulation is required, even at air temperatures as low as –40°F. For lighter work (2 METS), more clothing will need to added in order to maintain thermal comfort.

2. The US Army has two different clothing systems in the inventory for issue to troops operating in cold-weather conditions: a Cold/Wet-Cold/Dry Clothing System (FM 31-70), and an Extended Cold-Weather Clothing System (FM 21-15).

a. Soldiers deployed to cold-weather areas from stations in warm regions can be issued the combination Cold/Wet-Cold/Dry Clothing System that can be configured into two ensembles. The cold/wet ensemble is worn above 14°F (-10°C), and the cold/dry ensemble is worn below 14°F. The cold/dry ensemble protects down to -60°F (-51°C). The cold/wet configuration differs from the cold/dry in the number of layers and the choice of boots. This system uses layers of wool/cotton fabrics to trap air for insulation, and a water-repellent outer garment to maintain dryness. Wool/cotton fabrics can retain moisture which decreases their insulation. Therefore, it is important that the clothing remain dry. These fabrics also become heavy when wet, making work more difficult

b. Soldiers regularly stationed in cold-weather regions are usually issued the Extended Cold-Weather Clothing System (ECWCS), which protects from +40°F (4°C) to -60°F (-51°C). ECWCS consists of 5 layers: polypropylene underwear, a polyester fiberpile shirt and bib overalls, polyester coat liner and field pants, nylon/GORE-TEX® laminate parka and trousers, and nylon overgarments (parka and trousers). The inner layers are made of fabrics that draw perspiration away from the skin. The outer layer is made of a material that repels outside water while allowing perspiration to escape. Either the cold-weather vapor barrier boot (Type I) or the extreme cold-weather vapor barrier boot (Type II) can be worn with one pair of nylon/cotton/wool socks (OG-106). Vapor barrier boots can cause trenchfoot. Socks must be changed frequently. The Combat Vehicle Crewman's Hood (Balaclava) is worn under the PASGT helmet. The polypropylene layer and the nylon/GORE-TEX® Parka and trousers should always be worn to prevent perspiration from building up inside the clothes. The Parka and trousers should not be worn during strenuous exercise because if they become saturated with sweat, the water will freeze and the garment will lose its breathability. Wool or wool blends should not be worn in the intermediate layers of the ECWCS because they retain moisture.

c. Feet, hands and exposed skin must be kept dry. **Feet are particularly vulnerable and extra foot care is required for cold-weather operations**. Feet should be washed, dried and dusted with a dry, antifungal powder (NSN 6505-01-008-3054) daily. Socks must be changed whenever they become wet from exposure to rain or snow, or from sweat. This may require changing into **dry socks at least 2-3 times daily**. Extra socks can be air dried and then carried under BDU's to warm.

3. Several varieties of handwear protection are available for issue.

a. Most soldiers receive the standard light-duty leather glove that is worn with a 50% wool, 50% nylon liner inserted. This handwear ensemble provides inactive persons with about 30 minutes of protection from frostbite when air temperature is 0°F (-18°C). If temperatures are warmer and/or soldiers are physically active, the handwear ensemble will provide effective protection for longer periods. The light-duty leather glove is not waterproof. When active, care should be taken that sweat from hands does not accumulate in the glove and degrade insulation.

b. When the standard light-duty leather glove provides inadequate protection (i.e. air temperature below 0°F (-18°C), or more than 30 minutes of inactive exposure anticipated), trigger finger or Extreme Cold Weather mittens and liners can be worn.

4. Because the combination of cold-weather clothing and equipment is heavy and cumbersome and working in snow, ice or mud is very strenuous. Snowshoes or skis should be used for dismounted troop movement when loose snow is deeper than 15 inches (38 cm). Although easier than walking through deep snow, snowshoeing, and skiing are hard work and troops require proper equipment and training to use these techniques. Building fighting positions and moving troops requires more time and physical effort. Digging may be very difficult or impossible in frozen ground. Building defenses in hard frozen ground may require engineer support in the form of heavy equipment for digging and plowing.

a. The increased effort can result in overheating and sweating especially during hard work, and can contribute to increased fatigue.

b. Sweat buildup and overheating should be minimized by ventilating clothing and **removing layers** (especially outer shell) during heavy work and scheduling frequent short rest breaks.

Shelter

1. The US Army has several heaters for use inside tents during cold weather.

a. The type of heater required depends on the size of the tent or shelter to be heated. The Space Heater Arctic (NSN 4520-01-444-2375) is used to heat the Arctic 10 Man Squad Tent, 5 man tents and GP small tents. Other stoves carried by the soldier can be used to melt ice and snow or to heat water. They can also be used to provide minimal heat in small shelters.

b. Care must be used to prevent melting the frozen ground beneath or around the heater because it may melt unevenly and cause the heater to tip over, or it will increase the chance that a soldiers' clothing will become wet. By using a tent liner, removing loose snow and ice from the ground before setting up the tent, and preventing the tent from overheating, melting can be minimized. If available, plywood tent flooring and metal trays under the stove can be used to reduce melting.

2. Shelter from weather is critical for protection from wind and precipitation and to create a warmer environment. The standard shelter is the tent, but improvised shelters (snow caves, snow trenches, lean-tos etc.) can be constructed from local materials.

3. The recommended sleeping system is the Modular Sleeping Bag System (NSN 8465-01-393-1154) on top of a closed-cell foam Sleeping Mat (NSN 8465-01-109-3369).

a. Layers of tree boughs (if a mat is unavailable) under the sleeping bag help reduce heat loss to the ground. The sleeping bag should be shaken out before using to add air to the lining, which improves its insulation.

b. In tents, soldiers should sleep in long underwear and socks with all other clothing hung up to dry. In improvised shelters, only boots and the outermost clothing layer should be removed. Place clothing under the sleeping bag where it can add insulation without accumulation moisture from the body. Ice should be removed from vapor barrier boots, and they should be wiped dry on the inside and, if possible, allowed to air out before putting them on again. In extreme cold, a balaclava or some other head cover should be worn while sleeping to protect the ears, neck, and face. The arctic mittens can be worn on the feet while inside the sleeping bag to help keep the feet warm. The head should not be put inside the sleeping bag, since moisture from the breath will accumulate in the bag, reducing its insulation.

c. Air out the sleeping bag as often as possible to evaporate moisture.

d. Minimize the risk of cold injuries in fighting positions, sentry points and observation points by placing pads, sleeping bags, tree boughs, etc inside these positions to allow occupants to insulate themselves from the ground or snow.

Sun, Low Humidity & High Altitude

Besides cold temperatures, wind, and rain, other environmental stressors will be encountered during cold-weather operations. For example, winter operations in the coastal regions of the eastern United States or the Arabian Gulf of Southwest Asia may be conducted during periods of near-freezing temperatures, rain and wind. Heavy snow may be encountered during winter operations in areas of northern Europe, North America, Afghanistan, Iraq, and throughout the year in mountainous regions. In desert, arctic and high altitude regions, very low temperatures are often accompanied by high winds, low humidity, very bright sun, or a combination of those conditions. The influence of wind and rain on the severity of cold stress has been discussed in the last section. However, sun, wind, snow, rain and low humidity each present environmental health threats in and of themselves.

Understanding the Problems:

1. Exposure of unprotected skin and eyes to sunlight may cause **sunburn and snow blindness**. The threat of sunburn and snow blindness depends on the intensity of sunlight, not the air temperature. Snow, ice and lightly colored objects reflect the sun's rays, increasing the potential for injury. Sunburn and snow blindness can last hours to days and can cause temporary incapacitation.

FIRST AID FOR OVEREXPOSURE TO SUN AND WIND:

1. **PREVENT FURTHER EXPOSURE**
2. **TREAT MILD SUNBURN, WINDBURN AND CHAPPING WITH MOISTURIZING LOTIONS, AND ASPIRIN OR TYLENOL, BUT EVACUATE FOR MEDICAL TREATMENT IF LARGE AREAS OF SKIN ARE INJURED OR BLISTERED**
3. **FOR SNOW BLINDNESS, HAVE VICTIM REST IN DARK AREA WITH EYES COVERED WITH COOL, WET BANDAGES UNTIL EVACUATED**

a. Sunburned skin will appear red, hot to the touch, possibly swollen and blistered, and will be painful. Sunburn will increase heat loss during cold exposure.

b. Solar radiation can "sunburn" unprotected eyes resulting in snow blindness. Sunburned eyes are painful, may feel gritty, and profuse tearing, blurred vision, and headache may occur.

c. Using sunscreen that contains para amino benzoic acid (PABA) or other chemicals capable of blocking ultraviolet radiation (at least 15 Sun Protection Factor) and covering exposed skin will prevent most sunburn. In cold weather, use alcohol-free sunscreen lotion (Sunscreen Prep, NSN 6505-01-121-2336).

d. The use of protective eyewear (Sunglasses, Polarized, NSN 8465-00-161-9415) or goggles that block at least 90% of ultraviolet radiation helps to prevent snow blindness. ***Not all commercially available sunglasses block enough solar radiation to protect against snow blindness.***

2. Cold climates may also have low humidity.

a. Low humidity and windy conditions cause drying of the lining (mucous membranes) of the nose, mouth, and throat causing nosebleeds, sore throat, and minor respiratory difficulties as well as chapping of the skin, increasing the sensitivity to sunburn, and chaffing. Wind blown debris entering the eyes can lead to eye irritation, injury, and infection.

b. Chapped lips and skin can be prevented through the use of lip balm (Cold Climate Lipstick, Antichap, NSN 6508-01-277-2903) and limiting exposure of skin to the environment. Skin moisturizing lotion may help the skin retain water.

c. Covering the nose and mouth using a balaclava or scarf will limit the drying of mucous membranes.

3. High altitude exposure is combined with cold air temperatures.

a. When exposed to high altitude, shivering and vasoconstriction are lower, increasing the risk for hypothermia. The combination of cold and altitude also decreases blood flow to the extremities increasing the risk for frostbite.

b. High altitude regions can be dry increasing respiratory water loss and causing dehydration. Proper water intake must be maintained.

c. High altitudes decrease physical performance, lowering heat production by exercise.

Food and Water During Cold-Weather Operations

Although warm clothing and proper shelter are the first line of defense in protecting against the effects of cold weather, adequate food and water consumption are next in importance. Food and water requirements of soldiers are high during cold-weather

operations and the effects of dehydration and inadequate diet are as serious as in hot climates.

Understanding the Problems:

1. Soldiers often become dehydrated during cold-weather operations due to sweating, decreased thirst, cold-induced diuresis, respiratory losses in dry air, conscious under-drinking, and poor water availability. Dehydration increases susceptibility to cold injuries by decreasing physical work ability, decreasing vasoconstriction, and degrading cognitive function. Dehydration also reduces appetite, alertness, and can lead to other medical problems such as constipation, kidney disorders, and urinary infections.

1. **The body's requirement for water is high during cold-weather operations.**

a. Even in cold weather, sweating can contribute to body water losses. Wearing too much clothing can cause overheating, especially during heavy work, which in turn leads to sweating. In cold dry conditions, sweat may evaporate readily without the individual sensing it, if well ventilated. Sweat losses in the cold can be as high as in the heat if heavy activities are combined with cold-weather clothing systems.

b. Unless water intake exceeds body water losses, dehydration will result.

2. Soldiers reduce their fluid intake during all field operations, but especially during cold weather.

a. Because field rations contain less water than garrison food, soldiers take in less water with the food they eat, and they usually do not drink enough to compensate.

b. Most people do not feel thirsty until they are already significantly dehydrated, and thirst may even less noticeable in cold as in hot weather.

c. When weather is particularly cold and/or rainy, many soldiers purposely allow themselves to become dehydrated to avoid having to leave comfortable shelter to urinate outdoors.

d. When temperatures are extremely low, water in canteens and bulk supply containers may freeze, restricting water availability. Transport of water to soldiers may also be problematic.

3. Soldiers rehydrate best at mealtime. Remind soldiers to drink at this time.

4. **Caloric requirements** of soldiers are 10 to 40% higher during cold-weather operations than in warm or hot weather. Approximately 4500 kcals (some more, some less depending on weight and activities) are needed.

a. Soldiers expend more energy during cold weather, due to a combination of clothing and equipment and the increased effort required for working or walking in snow or mud or for preparing positions in frozen ground.

b. The body uses more calories keeping warm when the weather is cold, which also contributes to the increased energy requirement.

6. Ensuring that soldiers in the field receive adequate amounts of ***hot*** rations is a major challenge for leaders during cold-weather operations, especially when soldiers are not stationed close to field feeding facilities or kitchens where rations can be heated and kept warm. Hot rations are important for morale, rewarming cold soldiers, and for promoting rehydration.

7. Other field-feeding problems often arise from freezing of rations and a lack of readily available liquid water to rehydrate dry ration components.

a. The most common individual ration soldiers receive during cold-weather operations is the Meal-Ready-To-Eat (MRE). Three to four standard MREs per day (1300 kcals per MRE) must be eaten to supply a soldier the necessary calories (4500 kcals total) during cold weather, if no other rations are provided. The MREs include liquid-containing components that can freeze during cold-weather operations if these items are not kept warm by carrying them inside the clothing.

b. Two other individual rations that U.S. soldiers may receive during cold-weather operations are the Meal, Cold Weather (MCW) and the Long Range Patrol (LRP). Soldiers must eat 3 MCW meals per day (4500 kcals total) or three LRPs per day (1572 kcals each) to obtain the necessary calories during cold-weather operations. Three canteens of water are needed to hydrate all parts of a MCW for a day.

WATER REQUIREMENTS FOR RECONSTITUTING DIFFERENT RATIONS:

1. **MEAL-READY-TO-EAT - ABOUT HALF A QUART FOR ALL DEHYDRATED COMPONENTS**

2. **MEAL, COLD WEATHER -**

   A. **ABOUT HALF A QUART FOR THE MAIN ENTREES ALONE**

   B. **ABOUT THREE QUARTS FOR ALL RATION COMPONENTS**

3. **LONG-RANGE PATROL - ABOUT ONE QUART FOR ALL COMPONENTS**

c. Even when troops in the field are served hot rations, meal items that are not normally heated (e.g. milk, juice, fruit cocktails, etc) can freeze making it difficult to serve and consume these items.

Coping with Water and Food Problems

1. Soldiers must drink even when they are not thirsty. Leaders should establish a program of regularly scheduled enforced drinking.

a. Inactive persons in comfortable climates need a minimum of 2 quarts of water a day to prevent dehydration. Using this as a basis, a general recommendation for soldiers participating in cold-weather operations is to consume about a half a quart (half a canteen) of water upon awakening, and half a quart with breakfast, lunch, and dinner. Water should be consumed during the workday (more if the work is strenuous enough to cause the individual to sweat). **A total of at least 3-6 quarts per day should be consumed**. Actual fluid requirements are dependent upon the level of physical work, air temperature, and clothing levels.

2. Hydration status can be monitored by noting the color and volume of a soldier's urine.

a. Soldiers should be taught that the more frequent the urination, the better hydrated they are; and that **dark yellow urine and small volume is a sure indicator that fluid consumption should be increased**.

b. Squad leaders should attempt to monitor urine color and volume of squad members. This is easiest if the ground is snow covered or frozen and a specific site is designated for squad members to urinate. The appearance of a dark yellow stain will be noticeable. Even if the particular individual cannot be identified, the squad leader can intensify efforts to encourage all squad members to increase fluid consumption.

3. In extremely cold weather (below -10°F or -23°C), standard issue canteens and the 5-gallon metal water containers can freeze.

a. It may be possible to wear the canteen or a spare water bottle inside one's clothing, perhaps tied by a string around the neck. Spare canteens should be kept inside heated vehicles or tents.

b. At least one full 5 gallon water container per squad should be kept thawed at all times. When that container begins to be dispensed, another full container should be brought inside for thawing. It can take several hours to thaw these containers in heated vehicles or tents.

c. Hands-free canteens (e.g., Camelbacks™) must be used with caution. They are susceptible to freezing if carried outside the body. The tubing and mouthpiece are especially vulnerable and these should be insulated. If carried inside clothing, the soldier must be aware that if the bladder breaks, the water will wet clothing and reduce the clothing's insulation, increasing the risk for cold injury.

4. Unmelted snow and ice should not be consumed for water. Eating snow and ice irritates the mouth, wastes body heat, and if enough is consumed, body temperature can be lowered. When snow or ice is the only available source of water, it should be thawed before being consumed. Melted snow and ice should not be considered as potable water until appropriately purified.

5. **There may be no better investment for the health, strength and morale of troops participating in cold-weather operations than to provide ample amounts of hot palatable food supplemented with warm beverages**. Proper prior planning is critical to successfully ensure that food is still hot when received by the individual soldier.

a. When soldiers are cold, they will naturally consume more food and beverages if served hot. Therefore, providing hot food and beverages offsets the usual reduced consumption in the field, helps to warm the soldier and improves morale.

b. The 10-40% extra calories most individuals need per day during cold weather can be obtained by eating a "normal" breakfast, lunch, and dinner, and then supplementing with frequent snacks throughout the day.

c. It is a good idea to save food items issued with regular meals to be eaten as between-meal snacks. Keep items such as MRE pouch bread, granola bars, candies, cookies, crackers, cheese and peanut butter spreads in your pocket, handy for frequent snacking.

d. A good tip for soldiers participating in cold-weather operations is to eat a snack before bed at night. This will help keep the individual warmer during sleep, which prevents shivering and allows sounder, more restful sleep. Soldiers should insure adequate insulation when sleeping since their core temperature decreases naturally during sleep.

e. There are many "old soldiers" tales concerning the best foods to eat during cold weather, but most soldiers simply need to eat larger amounts of a balanced diet than they do in garrison. Soldiers who must hike, ski or snowshoe for very long distances will benefit by eating more starchy foods such as crackers, potatoes, cereals, bread and noodles.

f. If soldiers pack personal supplemental food (pogey bait), the best choices are high carbohydrate, easy to eat, and easy to digest foods. During sustained

operations, energy bars (Hooah! bars) are a good snack. Keep food inside clothes to prevent freezing.

g. Some DOs and DON'Ts for Cold Weather Nutrition are:

DO

- Eat 10-40% more calories than usually eaten in garrison.
- Heat food and beverages at every opportunity.
- Drink more than thirst dicates.
- Eat snacks between meals and before going to sleep.

DON'T

- Eat snow or ice for moisture.
- Start new dietary habits
- Use field-training exercises to lose weight.
- Consume alcohol

6. Whenever possible, latrines should be sheltered to protect users from the wind and rain. Soldiers are less likely to restrict food and fluid intake, if they can use the latrines without being overly exposed to the elements.

Wounds, Disease and Nonbattle Injuries

Cold weather seriously degrades medical operations in the field. Combat casualties are more susceptible to cold injuries, cold slows wound healing, and cold weather can impede field medical treatment and evacuation. Furthermore, the incidence of disease and nonbattle injuries is increased during cold-weather operations.

Understanding the Problems:

1. Cold weather seriously affects care of battle casualties.

a. Medical equipment, medications and medication containers (e.g. IV containers, drug ampules) may freeze. Administration of IV medications or fluids is difficult in subfreezing temperatures due to freezing of solutions in lines or containers. Cold-weather clothing can make it more difficult to check the casualty for wounds and initiate treatment.

b. Shock may develop more rapidly and more severely when casualties are exposed to cold weather. Blood loss and shock increase susceptibility to frostbite and hypothermia. Sick or injured persons are often unable to sense the development of frostbite or hypothermia.

TREATMENT FOR SHOCK:

1. **KEEP WARM BY PLACING IN SLEEPING BAG OR SUBSTITUTE**
2. **RAISE LEGS ABOVE HEAD LEVEL, UNLESS PATIENT'S HEAD IS INJURED**
3. **LOOSEN CLOTHING WITHOUT COMPROMISING PROTECTION FROM COLD**
4. **IF CONSCIOUS, PROVIDE WARM DRINKING FLUIDS**
5. **MINIMIZE DISCOMFORT AND PROVIDE REASSURANCE**

c. Evacuation procedures may require modification. Litter bearers fatigue quickly in snow, ice or mud, slowing evacuation and putting the rescuers at risk of overexertion and cold injury. Mobile ground transport may be limited by road conditions. Air evacuation is limited by weather conditions. Open vehicles and aircraft can create tremendous windchill requiring measures to protect patients from cold injury during transport.

2. The widespread use of stoves and heaters in tents, other types of shelters and vehicles during cold-weather operations poses a risk of burns and injuries from unventilated exhaust fumes.

a. Burns result from contacting hot surfaces, fires, or explosions of stoves and fuel sources. Improper fueling and lighting techniques, or inadequate ventilation can result in the accumulation of flammable fumes into the tent or shelter. When ignited, these gases may cause potentially fatal fires.

IMMEDIATE FIRST AID FOR BURNS:

1. **MOVE CASUALTY AWAY FROM FIRE, REMOVE BURNING OR SMOLDERING CLOTHING**
2. **CUT AWAY CLOTHING OVER AND AROUND THE BURN UNLESS IT IS STUCK TO THE WOUND**
3. **COVER BURN WITH DRY, STERILE DRESSING, TIED AT EDGE, NOT OVER, THE BURN**
4. **DO NOT APPLY OINTMENTS, SNOW OR ICE TO THE BURN, AND DO NOT BREAK BLISTERS**

c. "Tent eye" is an inflammation and irritation of the eyes caused by exposure to fuel fumes which can accumulate in poorly ventilated shelters. Rubbing "itchy" eyes can subsequently lead to eye infection.

FIRST AID FOR TENT EYE AND CARBON MONOXIDE POISONING:

1. **MOVE CASUALTY TO FRESH AIR**
2. **ADMINISTER CPR IF NEEDED**
3. **REFER TO MEDICAL TREATMENT FACILITY FOR EVALUATION AND CARE**

d. Carbon monoxide (CO) is a poisonous gas which cannot be seen or smelled, and is contained in exhaust from stoves and vehicles. CO can build up in closed spaces without being noticed. Soldiers seeking shelter from the cold in poorly ventilated shelters or vehicles with the engine idling often become victims of CO poisoning. **Early signs of CO poisoning are headache, confusion, dizziness or drowsiness.** The lips and skin can become bright red. Victims will lose consciousness, and eventually die. Any person found unconscious in a closed tent or vehicle should be suspected of possible CO poisoning.

3. Proper field sanitation is very difficult to maintain during cold-weather operations. However, poor sanitation can lead to outbreaks of disease. Frequent close contact with others in shelters, combined with increased individual susceptibility due to fatigue, also contributes to the spread of disease.

a. Digging latrines and garbage pits can be difficult or impossible when the ground is frozen and covered with snow and ice.

b. Soldiers are not inclined to walk far to use the latrine or garbage pit when it is cold outside.

c. Improper food storage or garbage disposal will attract wildlife that can destroy clothing and equipment and bring disease.

d. The limited availability of hot water and the discomforts associated with undressing in the cold may discourage soldiers from maintaining proper personal hygiene.

e. Untreated drinking water obtained by melting snow and ice can contain disease.

4. Accidents due to slipping, sliding, falling and vehicular accidents will be more frequent during cold-weather operations. Paths, walkways and roads are frequently muddy or frozen. Heat escaping from the entrances of tents and buildings can cause cycles of thawing and freezing of the ground surface that make these areas particularly hazardous. Fatigue, the hobbling effect of clothing, and the effect of hoods and hats on vision and hearing will also contribute to accidents and falls.

Avoiding the Problems:

1. Keep liquid medications and medical equipment from freezing.

a. Store medications and medical equipment in heated areas of vehicles and shelters whenever possible to prevent freezing.

b. Some liquid medications can be carried inside the clothing of medical personnel where body heat will prevent freezing. IV fluid bags (with required tubing attached by tape) can be distributed to individual soldiers who can carry the bag inside their clothing.

c. Extra clothing and blankets should be available for use by patients during treatment and evacuation, especially when their clothing has become torn or soaked in blood. Check patients awaiting treatment and evacuation for cold injuries frequently.

2. Proper precautions will prevent injuries associated with use of stoves and heaters.

a. Only properly trained soldiers should be permitted to set up, light, refuel, and maintain stoves.

b. When a stove is being used, a fire guard should be posted, horseplay in the tent should be prohibited, and the tent doorway should be kept clear to allow easy escape.

c. The stovepipe should be kept clean and be tall enough to draft properly. Air intake to the stove should be unobstructed.

d. Shelters and tents should not be sealed so tightly that ventilation is completely blocked.

e. Sleeping in running vehicles should not be permitted. When vehicles are parked for long waits, occupants should ensure that exhaust pipes are not blocked by snowbanks, and a window should be opened slightly.

3. The principles of proper field sanitation are the same as in warm weather (FM 21-10-1), but their application during cold weather may require some modification of procedures.

a. Locate latrines and garbage pits at ***minimum*** allowable distances from the food service sites (100 yds or 90 meters, downwind) and unit water supply (100 feet or 30 meters), and clear snow and ice from paths leading to these areas making them more accessible. Provide latrines with as much shelter as possible. Commanders should prohibit indiscriminate waste disposal, and insist that soldiers use only properly designated latrine and garbage areas.

b. Snow and ice covering the ground may disguise the natural slope, and extra attention is required to ensure drainage from latrines and garbage pits is away from living areas. Freshly fallen snow can hide ice patches, mines or other hazards.

c. If the ground is too frozen to dig latrines and garbage pits, employ above ground containers (such as an empty MRE box lined with a plastic bag) to collect refuse. Ensure these containers are clearly marked to indicate the contents for proper disposal. Urinals can be cut into snow walls outside the bivouac.

d. Leaders should provide warm water frequently to encourage personal hygiene. Soldiers should wash hands, feet, face, and groin daily, whether or not heated water is available. During training exercises lasting several weeks, commanders should consider whether the health (and morale) benefits of arranging for troops to leave the field briefly for a break at a heated shower site might outweigh the temporary suspension of a realistic training scenario.

e. Food handlers should wash hands before serving and wear serving gloves when serving rations. Maintain larger stocks of large sizes of food serving gloves for food handlers to wear over glove liners when they are serving food outdoors.

f. Chlorine or iodine purification of cold water requires twice the usual amount of chemical and an extra 15 minutes waiting period before the water is safe to drink. Flavor enhancers should be added just before consuming the water.

4. Snow should be removed from the ground before tents are set up. Slippery paths and walkways should be marked with warning signs, and sand, salt, ashes or straw should be spread to increase traction.

SUSTAINING PERFORMANCE DURING COLD WEATHER

Soldier Tasks

Clothing and equipment malfunctions occur more often during cold weather. Simply wearing bulky cold-weather clothing restricts peripheral vision, movement, coordination, and manual dexterity. In combination, these effects can adversely impact the ability of soldiers to satisfactorily perform various aspects of their tasks.

Appreciating the problems:

1. The properties of materials used to make the clothing and equipment are altered by low temperatures. Rubber, plastic, other manmade fabric and materials and even metal can become brittle and break more easily when cold. Zippers will freeze and break, rendering garments unusable.

2. Moisture condensation is a common source of problems during cold-weather operations.

a. Moisture from sweat or breathing can become trapped in clothing or sleeping bags, condense and degrade insulation.

b. Condensation accumulates inside tents when they are occupied. This adds to the weight and makes it more difficult to pack and move them later.

3. Restricted visibility during cold-weather operations hampers many soldier tasks and particularly compromises operation of vehicles or weapons systems.

a. Cold eyeglasses, goggles, and eyepiece sights fog over easily when warm moist breath passes over them or when the wearer comes in from cold to warmed areas. If this condensation freezes, it is difficult to remove.

b. Hoods, balaclavas and other cold-weather headgear can restrict vision, particularly peripheral vision.

c. Depth perception is reduced when air temperature is below 0°F (-18°C) and/or wind speed is over 10 mph. Visual acuity is reduced when air temperature is below -20°F (-29°C) and/or wind speed is over 20 mph. These effects become particularly significant for viewing distances greater than 20 feet (6 meters).

d. Fog, rain, and blowing snow further restrict visibility. Ice fog is an unusual condition that occurs when the air temperature is extremely low (usually –40°F), and moisture arises from burning of fuels in engines, stoves, and firing weapon systems. The fog is produced when the moisture is trapped under a layer of cold air and wind is not present to disperse it.

4. Weapon use in extreme cold creates problems that can affect the health and performance of the operators.

a. Hangfires are more frequent, especially when the weapon has not recently been fired, due to effect of cold temperatures on ammunition burning. The M72A2 Light Antiassault Weapon (LAW) is particularly susceptible to hangfires in the cold. Backblast danger area is doubled for the LAW and tripled for the Dragon.

5. Metal can be dangerous to touch (contact frostbite) in extreme cold. Also, moisture will condense on cold metal exposed to heat. Unless removed, it will freeze upon being returned to the cold, and it can eventually lead to rusting. This is especially a problem with individual weapons.

6. Wearing gloves and mittens causes a significant loss of manual dexterity.

a. Conventionally-sized toggle switches, push-buttons, and control knobs, are difficult to operate when wearing gloves or mittens.

b. The decreased dexterity might encourage individuals to remove these protective items while working. However, removing the gloves will allow the fingers to cool and reduce blood flow to the hands, which will eventually degrade manual dexterity.

c. Blowing warm breath into mittens or gloves can cause the hands to become even colder. Air from the lungs contains moisture that will condense on the hands and wet the inside of the handwear, contributing to further hand cooling.

Optimizing Ability to Perform Soldier Tasks:

1. Whenever possible, avoid using clothing and equipment not specifically designed or tested for use in cold weather. Do not force frozen or stuck parts to move when they are cold. Lubricate zippers with wax.

2. Problems resulting from moisture trapped in clothing can be avoided.

a. Minimize overdressing, and remove clothing layers upon entering heated areas from the outside.

b. Dry clothing by hanging in the updraft of the tent to minimize condensation within the tent.

c. Ensure tents and other shelters have adequate ventilation to prevent accumulation of moisture.

3. Compensate for decreased visibility by increasing vigilance and slowing down. Avoid placing troops near traffic areas during periods of low visibility. Use antifogging compounds on eyeglasses and goggles.

4. Increase backblast areas and warm weapons by firing at a slow rate at first to minimize the chance of a hangfire or other malfunction.

5. To avoid condensation on small arms and ammunition, they should not be brought inside warm areas, unless outside storage and security is not practical.

a. If weapons are brought inside, they should be covered and placed near the floor to minimize condensation.

b. Clean and dry the weapon after it warms and before returning to cold.

6. For tasks requiring manual dexterity, commercially-available light-weight polypropylene glove liners can be worn beneath heavier gloves or mittens. The bulky outer glove can be removed to perform a task. Periodically, the outer glove can be replaced to allow the fingers to rewarm. With practice, soldiers will learn to compensate for the effects of gloves and other cold-weather clothing on manual dexterity, movement, and performance of various tasks.

7. Many tasks can be divided into shorter segments to allow rewarming breaks.

a. Brief rewarming periods in a heated shelter or even time spent with the gloves replaced may maintain sufficient manual dexterity so that the task can be completed.

b. It may be necessary to complete the task using a two-team approach, where one team works while the other rewarms.

c. Work should be planned to avoid extended periods of inactivity (e.g. in formation or awaiting transportation) while troops are outside in the cold.

NBC Operations

Cold weather makes all facets of military operations more difficult than in comfortable climates, but the impact on military functions during nuclear, biological or chemical warfare operations can be particularly significant. Problems should be anticipated and contingency plans should be developed before deploying.

Appreciating the Problems:

1. Nuclear weapon effects may be different in cold-weather operations than under other conditions. Troops operating in the open on frozen ground are especially vulnerable, since they will be unable to dig in rapidly.

a. Blast effects increase over frozen or ice-covered terrain due to the high reflectivity. Therefore, the radius of nuclear blast is increased, and minimum safe distances are increased, by as much as 50%.

b. Loose new fallen snow is a poor blast-reflecting surface, but a good thermal and flash-reflecting surface. Nuclear (and conventional) blasts can trigger avalanches.

c. Packed snow and ice as well as the frozen trunks and limbs of trees can be converted into many small missiles from the blast of nuclear and conventional warheads.

d. Snow, frost and rain generally reduce thermal effects on combustible materials on the ground surface, but subsurface fires may be ignited by nuclear detonations in heavy tundra.

e. Fallout patterns are difficult to predict in cold, windy conditions, and snowstorms can concentrate radioactive fallout.

2. Chemical agents can be used in cold environments.

a. The high freezing point of some agents limits their effectiveness during cold weather. However, the freezing point of certain nerve and choking agents is low (-40 to -77°F or –40 to -50°C), and some vaporize appreciably at temperatures as low as -44°F (-42°C). See Appendix E for a list of agents and their properties.

b. Frozen and unvaporized droplets of liquid chemical agents in snow will thaw and vaporize when contacting warm skin or when carried into heated shelters on clothing and equipment.

3. Many biological agents are resistant to low temperatures and may retain their potency for weeks or months, becoming active hazards during periods of warming and thawing or when the agents are carried into shelter on an individual's clothing.

4. During thaws, radioactive fallout, chemical and biological agents can be spread far from the areas of weapon deployment by natural run-off, and they can concentrate in areas of poor drainage.

5. The function of certain NBC protective clothing and equipment used to detect radiation and chemical agents is degraded in the cold.

a. Eyepiece fogging is very common when protective masks are worn in cold weather.

b. The material used in the chemical protective masks becomes stiff and brittle as temperatures fall below freezing, allowing them to be torn more easily than in warm weather, and making it difficult to achieve a proper seal.

c. The drinking tube on the M17 and M40 series mask will become unusable when temperatures are below freezing.

d. The batteries in the IM27 used to check for radiation fail when the instrument is not protected from below freezing temperatures.

e. M8/M9 detection paper is limited because only agents in liquid form can be detected.

f. The M8 chemical agent alarm requires the M253 winterization kit for use below 20°F (-6.7°C) and has a 50-minute warm-up time.

g. Chemical agent detectors sense volatilized agent vapors. Agents do not vaporize readily when it is cold, therefore the detectors respond more slowly to the presence of agents.

h. The solution in the capsules of the M256/M256A1 chemical detection kit can freeze, and once frozen, thawing may not restore their operability. Carry liquid components in breast pocket of chemical protective clothing. The kit does not work below –25°F (-32°C).

i. To prevent contamination from entering warmed areas in buildings, a vestibule or airlock that is warmed to the buildings temperatures will be needed.

6. Autoinjectors containing nerve agent antidote (atropine/pralidoxime) or anticonvulsant (diazepam) freeze at temperatures below 29°F (-2°C). Injection using the

autoinjector is more difficult when soldiers are wearing cold-weather clothing in addition to the NBC protective clothing.

7. Wearing NBC individual protective clothing and equipment during cold-weather operations increases the risk of injuries due to cold, and even heat stress.

a. NBC protective clothing can restrict the blood flow to the fingers and areas of the face, increasing the susceptibility of these areas to frostbite and limiting the ability to visually inspect for signs of cold injury. Heavy work will increase sweat accumulation in the gloves, increasing frostbite susceptibility in the fingers.

b. Mask carriers should be carried inside outer garments.

c. Wearing the impermeable NBC protective Battle Dress Overgarment (BDO) over heavy cold-weather clothing creates the unexpected situation where heat exhaustion becomes a real possibility for soldiers working hard, even in cold weather. The added insulation and decreased ventilation of NBC protective clothing can result in heavy sweating and wetting of the clothing during hard work, eventually degrading cold protection.

8. NBC decontamination procedures are extremely difficult under cold-weather conditions.

a. Water and decontamination solutions can freeze and may limit effective decontamination of vehicles or equipment.

b. Skin decontamination with the M291 Skin Decontamination Kit is effective in cold weather since all the components are dry. However, the older M258A1 kit still exists among war reserves in Germany and Korea and might be distributed. Use of the old M258A1 kit may result in frostbite during cold weather. Use of the alcohol pads in the M258A1 kit can supercool the skin.

Minimizing Effects of Cold on NBC Operations:

1. Brush off or remove outer clothing before entering tents and heated shelters to avoid bringing snow containing frozen contaminants inside to thaw and create an active hazard. Whenever practical, shovel or plow away the top layer of snow on trails, roads within occupied areas to limit the spread of contamination.

2. When NBC weapons have been employed in a region during the winter, avoid low-lying areas where run-off from rain or melting snow accumulates and concentrates toxic substances.

3. Practice integrating NBC protective clothing with cold-weather clothing. Some adjustments to procedure will be required.

a. Generally, the BDO is worn outside the cold-weather clothing, therefore, it may be necessary to remove insulating clothing layers before putting the BDO on to prevent overheating.

b. It may be necessary to add additional clothing layers over the BDO after it is donned, if changes in weather or activity warrant additional warmth. However, any garment worn over the BDO will become contaminated during chemical exposure and will have to be discarded and replaced with new issue clothing (leaders should anticipate this by having replacement clothing supplies on hand).

c. Vapor barrier boots or issue overboots are authorized replacements for chemical protective boots.

d. Chemical protective gloves are worn underneath cold-weather gloves and/or mittens. Individuals whose tasks require a high degree of manual dexterity may be unable to wear cold-weather gloves or mittens over the rubber gloves. In this case, polypropylene glove liners worn beneath the protective gloves may provide some protection from the cold for brief periods.

4. Using the protective mask during cold weather requires some additional procedural modification.

a. **Before deploying**, rivet heads inside the mask should be covered with adhesive tape to prevent possible contact frostbite. M3/M4 winterization kits should be installed on chemical protective masks (M17 and M40 series) when temperatures are below 23°F (-5°C). This kit contains an ice particle prefilter fitted over inlet valves to prevent frost accumulating on the inlet caps. It also includes two inlet valves and two nose cup valves of a softer rubber that does not become hard and brittle in the cold. M3/M4 winterization kits increase the work of breathing.

b. When it is cold, the protective mask should be donned normally. However, clearing the mask by the usual procedure of quickly exhaling maximally will fog the lens. Instead, exhale steadily and slowly.

c. The M6A2 hood should not cover the mask voicemeter outlet valve when the temperature is below freezing. The hood voicemeter outlet valve assembly cover should be pulled open below the voicemeter outlet valve assembly cover to allow moisture to escape.

d. To prevent the outlet valve from freezing and sticking to the seat, lift the outlet valve cover and rotate the disc while exhaling.

e. In extreme cold weather (< 0°F or -18°C), mask carriers must be worn under the parka to keep the mask warm and flexible enough to provide an adequate seal. Practice donning the mask when the carrier is worn under the parka.

f. **CAUTION!** Do not adjust the harness straps on the mask too tightly. This will reduce blood flow to skin of the head and face and can cause frostbite.

g. The mask should be wiped thoroughly dry after use to remove condensation that could freeze inside.

5. Radiation detectors (IM27), chemical agent alarms (M8), and chemical agent detectors (M256/M256A1) should be kept warm to ensure that batteries remain operational, and liquid containing components (M256/M256A1) do not freeze. Carry spare batteries inside clothing to keep them warm.

6. Chemical agent detector paper and tape and the M256/M256A1 detection kits all require more time in the presence of agents to give a positive indication when temperatures are below freezing.

a. Store the detector paper, tape and kits inside the parka during the day and in sleeping bags at night to keep them warm.

b. In extreme cold, chemical agents may not vaporize sufficiently to be sensed by detectors, so samples may need to be warmed in the presence of the detector, or the vapors concentrated by placing a box or bag over the suspected contaminant, and sampling from a small hole in the container.

7. Protect nerve agent antidote and anticonvulsant autoinjectors from freezing.

a. Autoinjectors should not be carried in the external pocket on the BDO when the temperature is below freezing. Place them in an inner pocket where body heat will keep them warm. A string should be tied to the autoinjector, and threaded through the outer layers of clothing and tied to an outside pocket or belt. The autoinjector can be rapidly extracted from within the clothing by pulling the string (practice this).

b. Frozen autoinjectors are still usable after being thawed if they do not appear broken or cracked.

8. When it is cold enough to freeze decontamination solutions or if using the alcohol pads from the M258A1 kit on the skin would risk frostbite, alternative dry decontamination can be accomplished.

a. Combining 2 parts supertropical bleach (STB) and 3 parts diatomaceous earth makes a dry mix that will inactivate chemical agents. This mixture can be used

directly on skin. Decontamination of footwear and skis is accomplished by using shuffle boxes containing the dry mix. Other clothing and equipment can be dusted with the mix.

b. Heated air blown over contaminated items removes chemical agents by evaporation. When decontamination solutions and/or water are frozen or not available, decontamination of vehicles and equipment can be accomplished using high temperature vehicle exhaust or forced air heaters. This decontamination method should only be performed outdoors. **The use of heated air will increase the contamination threat downwind.**

9. Pyridostigmine bromide (PB) is a pre-treatment given to soldiers at risk of chemical nerve agent exposure. PB does not adversely affect thermoregulation in the cold and PB does not increase susceptibility to hypothermia.

Leadership

The principles of leadership are unaffected by the weather, but challenges for leaders, especially of company and smaller-sized units, can be profound during cold weather. To accomplish their mission, leaders must contend with not only the enemy soldier, but also the stress of the environment on their men and equipment. The preceding sections have focused on the effects of cold weather on the soldier's biological functioning. However, the stress of cold can also adversely affect attitudes and morale, and leaders must recognize and cope with these effects to maintain their unit's effectiveness.

Leadership Challenges During Cold-Weather Operations:

1. Many soldiers come from regions where winters are not severe, and few have experience in living outdoors during cold weather. Initially, these soldiers may lack confidence in their ability to cope with and survive in cold weather.

2. The cold can seem inescapable. Even when soldiers are able to stay warm, the effects of cold are felt in awkward cold-weather clothing, confinement to small shelters and problems with vehicles and equipment. These effects can lead to anger, frustration and depression, which can be intensified by fatigue, periods of isolation, and shortened daylight hours.

3. When conditions are extremely cold and soldiers have been out for a long time, the need to stay warm tends to become the individual's most important concern.

a. Soldiers may appear confused or forget how to do things they are trained to do.

b. Some soldiers may attempt to shirk their duties in order to avoid the cold and stay warm.

4. The need to wear multiple layers of clothing or remain bundled in sleeping bags and blankets when it is cold, combined with extended periods of darkness can intensify the sense of isolation soldiers often experience when they are separated from home, family and friends. Some individuals respond to these feelings by "huddling up" to keep warm, and withdrawing within themselves away from the unit. This can lead to mental sluggishness, increased susceptibility to cold injuries and degrade individual effectiveness, unit discipline and cohesion.

Positive Leadership and the Right Attitude:

1. **Leaders are responsible for prevention of cold injury among their troops.**

a. Susceptibility to cold injury varies considerably, and safe exposure times for different soldiers exposed to the same cold-weather conditions also vary considerably.

b. Newly assigned individuals, who have little or no cold-weather training and experience, often sustain cold injuries.

c. Individuals with considerable cold-weather experience (often those in leadership positions) can become nonchalant or desensitized to the threat of cold injury. Leaders must be alert for carelessness even in soldiers experienced in cold weather operations.

2. Soldiers need to be taught that ***when it is cold, tasks may be more difficult, but they are not impossible.*** This knowledge comes from confidence in their abilities to survive and perform their mission during cold weather.

a. Leaders can build this confidence in their men by having them practice tasks and survival skills outdoors in the cold, and by conducting cold-weather training exercises.

b. After several weeks of training and experience in cold weather, most soldiers learn to cope fairly well.

c. Leaders must be alert and avoid the common trap of allowing cold-weather training exercises to become a camping trip. If this occurs, soldiers will become distracted from accomplishing their mission. Leaders must remind soldiers that their job is to fight, and the purpose of the training exercise is to teach them how to carry out their mission under cold-weather conditions.

3. A positive "can do" attitude helps in coping with cold-weather problems. Leadership must be aggressive and emphasize personal example to demonstrate that cold conditions are beatable.

a. Direct supervision should be emphasized.

b. Ensure duties are properly performed and work is equitably distributed among all unit members.

c. Be alert for individuals who have withdrawn from the group. Leaders should keep talking to their troops and encourage them to talk among themselves. Use the buddy system to maintain communication, and to watch for cold injuries.

d. Keep soldiers busy and physically active. Plan operations carefully to avoid unnecessary periods where troops are left standing in the open.

e. Use hot food to improve morale.

f. Allow soldiers more time to accomplish tasks and more discretion regarding how to accomplish them. However, do not allow them to use the cold as an excuse for failing to carry out orders, comply with unit SOP's or properly perform their duties.

PREPARATION FOR COLD-WEATHER OPERATIONS

1. Units preparing for deployment to cold-weather regions must anticipate the effects of the environment on the functioning of the individual as well as the unit. Preparation should involve steps to minimize those effects.

2. Units deploying to cold-weather regions should conduct training for their soldiers on basic winter skills and cold-weather survival.

a. It is especially important that soldiers practice wearing the cold-weather clothing to ensure that the fit is correct and the individual knows how to wear the gear.

b. Soldiers should practice performing their duties while wearing cold-weather clothing, since this gear restricts movement considerably. It is also important that soldiers practice donning individual NBC protective gear while wearing cold-weather clothing.

3. Winter operations are physically demanding, and troops must be in peak physical condition.

a. Units on alert, or identified for future deployment, should immediately optimize their physical training program, and spend more time training outdoors in the cold to accustom individuals to the effects of cold.

b. Outdoor training should not be halted when temperatures are cold. Rather than restrict outdoor activities at certain preselected temperatures, commanders should establish programs in which increasingly protective countermeasures (clothing, surveillance) are initiated as conditions become colder. Such programs build soldiers' confidence in their ability to complete their

COLD-WEATHER PREPARATION

INDIVIDUALS:

1. **LEARN TO SURVIVE AND PERFORM DUTIES IN THE COLD**
2. **OPTIMIZE PHYSICAL FITNESS**
3. **INSPECT-COLD WEATHER CLOTHING AND SURVIVAL KIT**
4. **PRACTICE WEARING COLD-WEATHER CLOTHING**
5. **MAINTAIN PHYSICAL FITNESS**

UNITS:

5. **CONDUCT COLD-WEATHER TRAINING**
6. **ESTABLISH UNIT BUDDY SYSTEM**
7. **IDENTIFY SUSCEPTIBLE TROOPS**
7. **EXPECT SUPPLY PROBLEMS (STOCK LARGE SIZE NBC INDIVIDUAL PROTECTIVE CLOTHING)**
8. **REASSESS SOPs FOR FIELD FEEDING, FIELD SANITATION, MEDICAL EVACUATION**

missions, regardless of weather. Appendix B shows recommended guidance for conducting, modifying, restricting or canceling training according to wind chill conditions.

4. Each soldier must have an individual cold-weather survival kit (Appendix D) and all required cold-weather clothing in proper working condition.

5. In addition to conducting training to help soldiers prepare to operate and survive under cold-weather conditions, unit leaders should anticipate how the disruption of normal unit procedures due to the weather conditions will affect unit operations.

a. Identify unit members who have previously experienced cold injuries. These soldiers should receive intensive retraining in cold-injury prevention, and should be monitored closely while deployed. Soldiers who have little or no cold weather experience should also receive thorough training.

b. Establish a buddy system within the unit to increase unit cohesiveness by minimizing the sense of isolation that individuals may experience during cold weather. A buddy system will also help to monitor for signs of cold injury among unit members.

c. Field sanitation procedures should be reviewed and modified as necessary if weather conditions are extreme. Aspects requiring particular re-emphasis include placement, maintenance and closure of latrines, water purification and sanitary food handling.

d. Anticipate supply difficulties, and stockpile emergency stores of critical items. During cold-weather operations, units will need more of the larger sizes of NBC protective clothing, since soldiers wear NBC clothing over multiple layers of bulky cold-weather clothing. Develop storage and transportation procedures for food and water that prevent freezing, and determine measures for thawing frozen supplies. Set up procedures for keeping rations hot until received by individual soldiers in the field.

e. Establish safety SOPs for personnel travelling by vehicle away from the unit's bivouac site. At a minimum, these SOPs should require all vehicle occupants to have their sleeping bag, extra clothing and individual survival kit with them whenever they leave the unit area. The SOPs should also designate what actions are to be taken in case the vehicle is disabled or the driver becomes lost.

KEY POINTS DURING COLD-WEATHER OPERATIONS

1. **SHELTER** FROM THE ELEMENTS IS SECONDARY ONLY TO DEFENDING AGAINST ENEMY ACTIONS.

2. **EAT AND DRINK MORE** FOOD AND FLUID THAN NORMAL.

3. **KEEP CLOTHING DRY**. REDUCE LAYERS AND VENTILATE TO ALLOW SWEAT TO EVAPORATE WHEN ACTIVITY INCREASES.

4. **BE PREPARED** FOR SUDDEN WEATHER CHANGES.

5. AVOID COLD INJURIES BY USING A **BUDDY SYSTEM AND FREQUENT SELF-CHECKS** ESPECIALLY WHEN INDIVIDUALS ARE NOT ACTIVE OR THEIR DUTIES REQUIRE THEM TO REMOVE THEIR GLOVES. USE THIN LINER GLOVES TO AVOID CONTACT FROSTBITE.

6. **IMMEDIATELY TREAT PERSONS SHOWING ANY SIGN/SYMPTOM OF COLD INJURY**. REWARM SOLDIERS WHO BEGIN TO SHIVER VIGOROUSLY.

6. **SICK, INJURED, AND WOUNDED INDIVIDUALS ARE VERY SUSCEPTIBLE TO COLD INJURIES.**

7. EACH SOLDIER SHOULD **CARRY AN INDIVIDUAL COLD-WEATHER SURVIVAL KIT** AT ALL TIMES.

8. DRIVERS AND PASSENGERS SHOULD **ALWAYS HAVE A SLEEPING BAG AND EXTRA COLD-WEATHER CLOTHING WHEN TRAVELING BY VEHICLE** AWAY FROM THE UNIT BIVOUAC LOCATION.

IF SEPARATED FROM YOUR UNIT DURING COLD WEATHER:

KEEP CALM

YOU MAY ONLY BE DISORIENTED. STOP, LOOK AND LISTEN FOR SIGNS OF THE MAIN UNIT. ATTEMPT TO RETRACE YOUR PATH BACK TO YOUR LAST KNOWN POSITION.

KEEP TOGETHER

GROUPS MUST NOT SPLIT UP. IF SCOUTING PARTIES ARE REQUIRED, THEY SHOULD CONSIST OF AT LEAST TWO SOLDIERS WHO GO ONLY SHORT DISTANCES AHEAD AND MARK THEIR TRAIL VERY CLEARLY.

KEEP WARM

ASSEMBLE OR IMPROVISE SHELTERS WHENEVER STOPPING, EVEN IF ONLY FOR A SHORT TIME. WHENEVER POSSIBLE, USE WOOD OR OTHER LOCALLY AVAILABLE FUEL FOR FIRES AND CONSERVE SUPPLIES. BURNING A SINGLE CANDLE INSIDE A TENT OR VEHICLE PROVIDES SOME HEAT.

KEEP FED AND HYDRATED

COLLECT ALL INDIVIDUAL FOOD AND WATER SUPPLIES AND INSTITUTE RATIONING.

KEEP SAFE

USE CAUTION WHEN TRAVELING AND AVOID NATURAL HAZARDS SUCH AS CLIFFS, ROCK SLIDE OR AVALANCHE AREAS. IF TRAVEL ON FROZEN RIVERS OR LAKES CANNOT BE AVOIDED, STAY NEAR THE BANKS, DO NOT STAND CLOSE TOGETHER AND WATCH FOR SPOTS OF UNSUPPORTED ICE RESULTING FROM CHANGES IN WATER LEVEL.

APPENDICES

APPENDIX A. Wind Chill Temperature

(DRAFT)

Wind Speed (mph) ↓

Air Temperature (°F)

	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-56	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95

RISK OF FROSTBITE (see times on chart below)

GREEN – LITTLE DANGER (frostbite occurs in >2 hours in dry, exposed skin)
YELLOW – INCREASED DANGER (frostbite could occur in 45 minutes or less in dry, exposed skin)
RED – GREAT DANGER (frostbite could occur in 5 minutes or less in dry, exposed skin)

Time to occurrence of frostbite in minutes or hours in the most susceptible 5% of personnel.

Wind Speed (mph) ↓

Air Temperature (°F)

	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	>2h	>2h	>2h	>2h	31	22	17	14	12	11	9	8
10	>2h	>2h	>2h	28	19	15	12	10	9	7	7	6
15	>2h	>2h	33	20	15	12	9	8	7	6	5	4
20	>2h	>2h	23	16	12	9	8	8	6	5	4	4
25	>2h	42	19	13	10	8	7	6	5	4	4	3
30	>2h	28	16	12	9	7	6	5	4	4	3	3
35	>2h	23	14	10	8	6	5	4	4	3	3	2
40	>2h	20	13	9	7	6	5	4	3	3	2	2
45	>2h	18	12	8	7	6	4	4	3	3	2	2
50	>2h	16	11	8	6	5	4	3	3	2	2	2

WET SKIN COULD SIGNIFICANTLY DECREASE THE TIME FOR FROSTBITE TO OCCUR.

APPENDIX B. Cold-Weather Training Guidelines

Windchill Category

(see Windchill table)

Work Intensity	Little Danger	Increased Danger	Great Danger
High **Digging foxhole, running, marching with rucksack, making or breaking bivouac**	Increased surveillance by small unit leaders; Black gloves optional - mandatory below 0°F (-18°C);	ECWCS or equivalent; Mittens with liners; No facial camouflage; Exposed skin covered and kept dry; Rest in warm, sheltered area; Vapor barrier boots below 0°F (-18°C) Provide warming facilities	Postpone non-essential training; Essential tasks only with <15 minute exposure; Work groups of no less than 2; Cover all exposed skin, Provide warming facilities
Low **Walking, marching without rucksack, drill and ceremony**	Increased surveillance; Cover exposed flesh when possible; Mittens with liner and no facial camouflage below 10°F (-12°C); Full head cover below 0°F (-18°C). Keep skin dry - especially around nose and mouth.	Restrict Non-essential training; 30-40 minute work cycles with frequent supervisory surveillance for essential tasks. See above.	Cancel Outdoor Training
Sedentary **Sentry duty, eating, resting, sleeping, clerical work**	See above; Full head cover and no facial camouflage below 10°F (-12°C); Cold-weather boots (VB) below 0°F (-18°C); Shorten duty cycles; Provide warming facilities	Postpone non-essential training; 15-20 minute work cycles for essential tasks; Work groups of no less than 2 personnel; No exposed skin	Cancel Outdoor Training

These guidelines are generalized for worldwide use. Commanders of units with extensive extreme cold-weather training and specialized equipment may opt to use less conservative guidelines.

General Guidance for all Cold-Weather Training

Skin: Exposed skin is more likely to develop frostbite, therefore cover skin. Avoid wet skin (common around the nose and mouth). Inspect hands, feet, face and ears frequently for signs of frostbite.

Clothing: Soldiers must change into dry clothing at least daily and whenever clothing becomes wet, and must wash and dry feet and put on dry socks at least twice daily.

Nutrition: 4500 calories/day/soldier. Equivalent to 3 meal packets in meal-cold weather (MCW) or 3-4 MRE's.

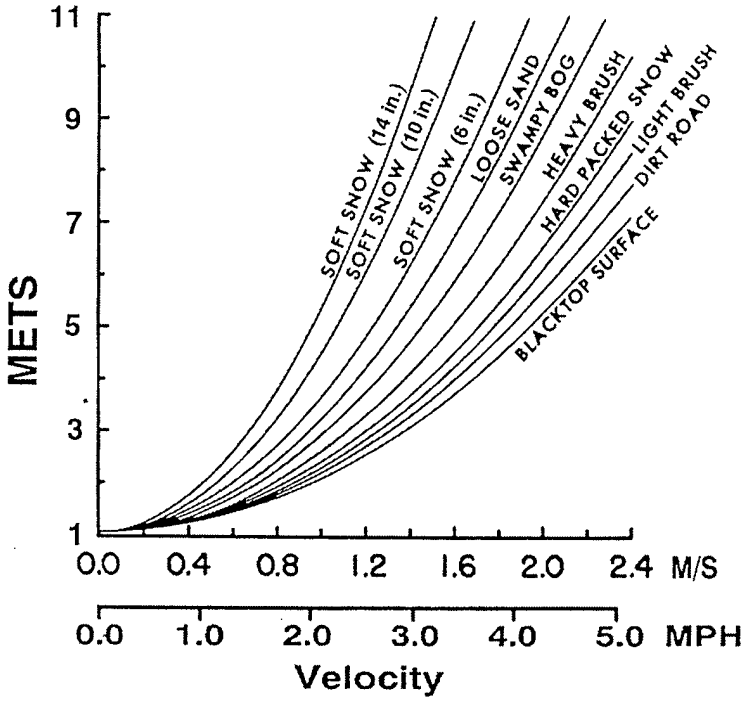
Hydration: 3-6 Liters (canteens)/day/soldier. Warm, sweet drinks are useful for re-warming.

Camouflage: Obscures detection of cold injuries; Not recommended below 10°F.

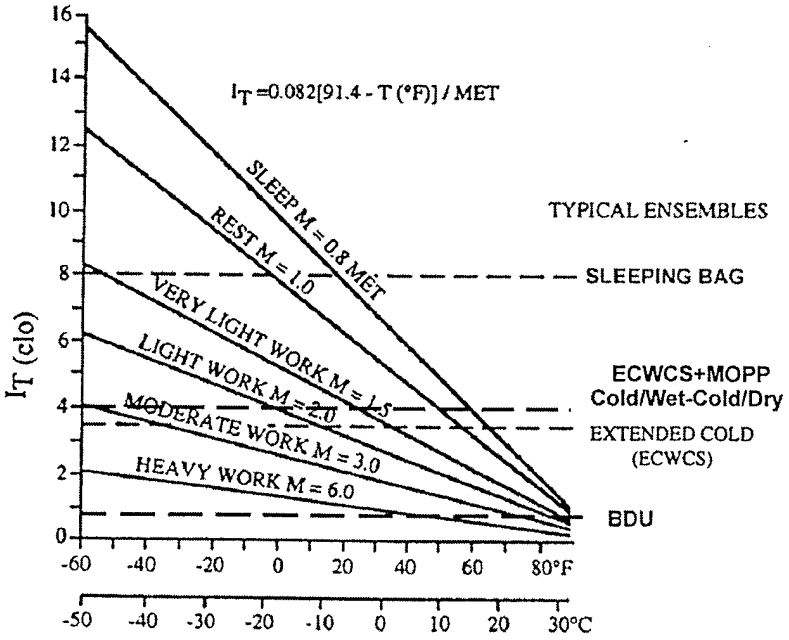
Responsibilities: Soldiers are responsible for preventing individual cold injuries. Unit NCO's are responsible for the health and safety of their troops. **Cold injury prevention is a command responsibility.**

APPENDIX C. Graphs of Metabolic Rate & Clothing

A.



B.



APPENDIX D. Individual Cold-Weather Survival Kit

1. Waterproof matches and fire starter (eg. candle, magnesium match)
2. Signaling devices (eg. mirror and whistle)
3. Knife
4. Pressure Bandage, cold-climate lip balm, sunglasses
5. Compass
6. Water container (metal, for use in fire)
7. Small amount of concentrated food (eg. MRE or Trail mix)
8. Foil survival blanket (NSN 7210-00-935-6667)

APPENDIX E. Freezing Points of Selected Chemical Agents

Agents	Symbols	Contact Hazard	Vapor Hazard	Freezing Point
NERVE				
Tabun	GA	Extreme	Low-moderate	+23°F
Sarin	GB	Extreme	Extreme	-69°F
Soman	GD	Extreme	Probable	-44°F
	GF	Extreme	Probable	-22°F
	VX	Extreme	Negligible	-60°F
	VR-55	Extreme	Probable	Unknown
	TGD	Extreme	Probable	Depends on % thickener
BLISTER				
Distilled Mustard	HD	Extreme	Negligible	+57°F
Mustard-lewisite	HL	Extreme	Low	-14°F (pure) -44°F (plant purity)
Nitrogen Mustard	HN-1	Extreme	Low	-29°F
Nitrogen Mustard	HN-2	Extreme	Low	-76°F
Lewisite	L	Extreme	Negligible	0°F
Nitrogen Mustard	HN-3	Extreme	Low	+25°F
Phosgene Oxime	CX	Extreme	Low	+95°F
BLOOD				
Hydrogen Cyanide	AC	Low	Extreme	+8°F
Cyanogen Chloride	CK	Low	Extreme	+20°F
Arsine	SA	Low	Extreme	-177°F
CHOKING				
Phosgene	CG	Slight	Extreme	-198°F
Diphosgene	DP	Slight	Extreme	-71°F

APPENDIX F. Further Reading

Department of the Army, FM 31-70, Basic Cold Weather Manual

Department of the Army, FM 31-71, Northern Operations

Department of the Army, FM 31-72, Mountain Operations

Department of the Army, FM 21-10, Field Hygiene and Sanitation

Department of the Army, FM 21-11, First Aid for Soldiers

Department of the Army, TC 21-3, Soldiers Handbook for Individual Operations & Survival in Cold Weather Areas

Department of the Army, TB MED 81, Cold Injury (Under Revision, To be released as TB MED 508).

US Army Northern Warfare Training Center, Fort Greely, Alaska, Winter Operations Manual

Department of the Navy, FM 7-23, Small Unit Leader's Guide to Cold Weather Operations

DISCLAIMER

This document does not replace policy and doctrine established by Headquarters, Department of the Army, Training and Doctrine Command, Forces Command, Northern Warfare Training Center or contained in TB Med 508 and other official publications. Rather, information has been integrated from a variety of sources including studies conducted by this Institute, observations made by Institute personnel who have accompanied troops deployed during cold-weather training exercises (e.g., Arctic Warrior), and information extracted from manuals, circulars, and bulletins published concerning aspects of cold-weather operations. We encourage readers to provide critical comments and examples of their own "lessons-learned" about cold-weather operations to:

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